SUBSECTION 4.13
DENSE-GRADED HOT-MIX ASPHALT (METHOD)

I. **Description:** The contractor will construct a pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant.

II. **Material:** The contractor shall furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. The contractor will notify the ODR (Owner Designated Representative) of all material sources. Notify the ODR before changing any material source or formulation. When the Contractor makes a source or formulation change, contractor shall provide verification that the requirements of this Item are met and the ODR, or Engineer may require a new laboratory mixture design, trial batch, or both. The ODR or Engineer may perform sampling and testing of project materials at any time during the project to verify compliance.

A. **Aggregate:** The contractor will furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either coarse aggregate or fine aggregate. When reclaimed asphalt pavement (RAP) is used, provide RAP stockpiles in accordance with this Section. Aggregate from RAP is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply mechanically crushed gravel or stone aggregates that meet the definitions in Tex-100-E. The ODR or Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. Surface Aggregate Classification (SAC) of supplied materials are to be listed in the most current TXDOT *Bituminous Rated Source Quality Catalog* (BRSQC) for material sources on the TxDOT's *Aggregate Quality Monitoring Program* (AQMP), or provided by the contractor. The Contractor will perform all other aggregate quality tests listed in Table 1. The contractor shall document all test results on the mixture design report. The ODR or Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. The contractor will determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the TxDOT's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved. Aggregates from non-listed sources may be used only when tested by the Contractor and approved by the ODR.

1. **Coarse Aggregate:** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Provide aggregates from sources listed in the BRSQC, or provide testing to verify compliance.

   The contractor will provide coarse aggregate with at least the minimum SAC shown in Table 1 or as otherwise shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. The SAC for sources on the TxDOT's *Aggregate Quality Monitoring Program* (AQMP) is listed in the *Bituminous Rated Source Quality Catalog* (BRSQC).

   Class B aggregate meeting all other requirements in table 1 may be blended with a class A aggregate in order to meet requirements for class A materials. When blending class A and B aggregates to meet a class A requirement, ensure that at least 50% by weight of the material retained on the no. 4 sieve comes from the class A aggregate source. Blend by volume if the bulk specific gravities of the class A and B aggregates differ by more than 0.300. When blending, do not use class C or D aggregates. For blending purposes, coarse aggregate from rap will be considered as class B aggregate.

2. **Fine Aggregate:** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The ODR or Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 2, unless otherwise approved.

a) If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	Class B, unless otherwise shown on the plans.
Deleterious material, %, max	Tex-217-F, Part I	1.5
Decantation, %, max	Tex-217-F, Part II	1.5
Los Angeles abrasion, %, max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	30[1]
Coarse aggregate angularity, 2 crushed faces, %, min	Tex 460-A, Part I	85[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, min	Tex-203-F	45

1. Unless otherwise shown on the plans.
2. Unless otherwise shown on the plans. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

3. RAP: RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. When RAP is used, no more than the amounts shown in Table 3 will be accepted. When RAP is used, determine asphalt content and gradation for mixture design purposes. Perform other tests on RAP when shown on the plans. Crush or break RAP so that 100% of the particles pass the 2-in. sieve.

RAP used in ACP will be fractionated. Fractionated RAP is defined as having 2 or more RAP stockpiles whereas the RAP is divided into coarse and fine fractions. The coarse stockpile will contain only material retained by processing over a 3/8 in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8 in. screen unless otherwise approved. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP. Utilize a separate cold feed bin for each stockpile of Fractionated RAP used.

Do not use RAP contaminated with dirt or other objectionable materials. Do not use the RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with the laboratory method given in Tex-406-A, Part I. Determine the

plasticity index using Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction.

RAP from either Contractor- or City-owned sources, including RAP generated during the project, is permitted only when shown on the plans. City-owned RAP, if allowed for use, will be available at the location shown on the plans. Do not intermingle Contractor-owned RAP stockpiles with City-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused City-owned RAP to the designated stockpile location.

a) Maintenance Mix: Hot mix asphalt purchased by the City of Amarillo to be used by City forces for the construction and repair of city streets will have the following recycled material requirements:

The City of Amarillo herein is specifying that no more than 20% RAP will be allowable during the summer months, April thru September, and no more than 5% RAP will be allowable during the winter months, October thru March.

Table 3
Maximum Allowable Recycled Binder (%)*

RAP	20
RAS	5

*For mix designs containing combined RAP and RAS use no more than 20% total recycled binder and no more than the stated maximum of each.

4. **RAS:** RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is defined as processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is permitted unless otherwise shown on the plans. Up to 5% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 3. Comply with all regulatory requirements stipulated for RAS by the TCEQ.

   Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

   Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 5% of the HMA mixture.

   Certify compliance of the RAS with TxDOT's DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established non hazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on TxDOT's MPL or approved equal. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved.

   a) Maintenance Mix: Hot mix asphalt purchased by the City of Amarillo to be used by City forces for the construction and repair of city streets is to have the following recycled material requirements:

The City of Amarillo herein is specifying that no RAS will be allowable during the winter months, October thru March.

B. **Mineral Filler:** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, cement, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Does not use more than 2% hydrated lime or cement, unless otherwise shown on the plans. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

1. is sufficiently dry, free-flowing, and free from clumps and foreign matter;

2. does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and

3. meets the gradation requirements in Table 4.

Table 4
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

C. **Baghouse Fines:** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

D. **Asphalt Binder:** The contractor shall furnish the type and grade of performance-graded (PG) or asphalt cement (AC) asphalt binder specified on the plans in accordance with Item 4.18, "Asphalts, Oils, and Emulsions". The contractor will provide the ODR copies of all asphalt invoices.

E. **Additives:** When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved.

Asphaltic mixtures with aggregate which exhibit stripping characteristics will be conditioned with either minimum 1% lime in accordance with TxDOT's DMS-6350, or liquid anti-stripping agent approved by the ODR, or Engineer

If lime or a liquid antistripping agent is used, add in accordance with Item 4.19, "Asphalt Antistripping Agents".

Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

F. Mixture Design:

1. **Design Requirements:** Use a Level II specialist certified by a Texas Asphalt Institute-approved hot-mix asphalt certification program to develop the mixture design. Have the Level II specialist sign the design documents. Unless otherwise shown on the plans, use the typical weight design example given in Tex-204-F, Part I, to design a mixture meeting the requirements listed in Tables 1 through 7. Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design.

The TxDOT Construction Division maintains a list of approved laboratories. Furnish the ODR, or Engineer with copies of all testing for approval of the mixture design. If the design cannot be verified by the ODR, or Engineer, furnish another mixture design. If the contractor uses a Super Pave Press to design the ACP mix it shall be noted on the design submitted to the ODR. Superpave gyrations will be noted on contractor's design.

The Contractor may submit a new mixture design at anytime during the project. The ODR or Engineer will approve all mixture designs before the Contractor can begin production.

Provide the ODR, or Engineer with a mixture design report using approved software. Include the following items in the report:

a) The combined aggregate gradation, source, specific gravity, and percent of each material used;

b) Results of all applicable tests;

c) The mixing and molding temperatures;

d) The signature of the Level II person or persons who performed the design; the date the mixture design was performed; and

e) A unique identification number for the mixture design.

Table 5
Master Gradation Bands (% Passing by Weight or Volume)
and Volumetric Properties

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
1-1/2"	98.0–100.0	–	–	–	–
1"	78.0–94.0	98.0–100.0	–	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	–	–
1/2"	50.0–70.0	–	–	98.0–100.0	–
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	80.0–86.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA[1], % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Plant-Produced VMA, % Minimum					
–	11.5	12.5	13.5	14.5	15.5

1. Voids in Mineral Aggregates.

Table 6
Laboratory Mixture Design Properties

Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	97.0[1]
Design gyrations (Ndesign for SGC)	Tex-241-F	50[2]

1. Unless otherwise shown on the plans.
2. Adjust within a range of 35-100 gyrations when approved by ODR.

Hamburg Wheel Test Requirements[1]

High-Temperature Binder Grade	Minimum # of Passes[2] @ 0.5" Rut Depth, Tested @ 122°F
PG 64[3] or lower	10,000
PG 70	15,000
PG 76 or higher	20,000

1. Tested in accordance with Tex-242-F.
2. May be decreased or waived during production when shown on the plans.
3. If AC is used, it must show it meets the requirements of PG 64.

G. **Job-Mix Formula Approval:** The job-mix formula (JMF) is the combined aggregate gradation and target asphalt percentage used to establish target values for mixture production. JMF is the original laboratory mixture design used to produce the trial batch. The ODR, or Design Engineer and the Contractor will verify JMF based on plant-produced mixture from the trial batch unless otherwise approved. The ODR or Engineer may accept an existing mixture design less than one (1) year old and may waive the trial batch to verify JMF. If the JMF is not verified by the ODR, or Engineer from the trial batch, adjust the JMF or redesign the mix and produce as many trial batches as necessary to verify the JMF.

H. **JMF Field Adjustments:** The contractor will produce a mixture of uniform composition closely conforming to the approved JMF.

If, during initial days of production, the Contractor, ODR, or Engineer determines that adjustments to the JMF are necessary to achieve the specified requirements, or to more nearly match the aggregate production, the ODR may allow adjustment of the JMF within the tolerances of Table 8 without a laboratory redesign of the mixture.

The contractor may adjust the asphalt content with the approval of the ODR to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

III. Equipment: The contractor will provide the required or necessary equipment in accordance with Item 4.20, "Equipment for Asphalt Concrete Pavement" and Item 4.21 Weighing and Measuring Equipment.".

IV. **Construction:** The Contractor shall design, produce, store, transport, place, and compact the specified paving mixture in accordance with the requirements of this Item. The Contractor will perform quality assurance (QA) testing at the scope and frequency outlined in the Quality Assurance section below. QA sampling and testing conducted by the Contractor will be reviewed by the ODR to determine payment and

make acceptance decisions. The Contractor may perform quality control (QC) testing to additionally monitor production and placement operations and shall provide to the ODR upon request.

A. **Quality Assurance:** The Contractor shall provide QA tests results immediately to the ODR via email or hard copy.

1. **Production Acceptance (QA):** The contractor shall control the production process within the operational tolerances listed in Table 8. When outside operational tolerances the mix will be removed and replaced. Q/A testing will be performed at the frequency shown in Table 8.

2. **Placement Acceptance (QA):** The contractor shall control the placement process within the placement tolerances specified in Table 8. When outside specified tolerances the mix will be removed and replaced. Q/A testing will be performed at the frequency shown in Table 8.

    a) The Contractor shall core the pavement at random locations identified and marked by the ODR or his representative. Cores will be taken in pairs. The contractor will be required to take a minimum of 1 set of cores per days production. If more than one street or alley is paved, a set of cores will be required on each alley or street.

Table 8
Quality Assurance

Description	Test Method	Tolerance	Testing Frequencies
Production			
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	±5.0*	1 Per days production
Individual % retained for sieves smaller than #8 and larger than #200		±3.0*	1 Per days production
% passing the #200 sieve		±2.0*	1 Per days production
Asphalt content, %	Tex-236-F	±0.3*	1 Per days production
Laboratory-molded density, %	Tex-207-F	±1.0*	1 Per days production
VMA, %, min		Test and verify that Table 5 requirements are met	1 Per days production
Theoretical Maximum Specific Gravity	Tex-227-F		1 Per days production
Placement			
In-place Air Voids	Tex-207-F and Tex-227-F	5% to 9%	1 Per days production[3]
Thickness		As shown in Table 10	1 Per days production[3]
Ride for Arterial Streets	Tex-1001-S	65 to 95 IRI	All lanes[2]
Ride for Residential Streets		1/8" in 10 ft	All lanes[2]

*Allowable Difference from Design and/or JMF Target

2. Not required on overlays.

3. Minimum 1 test per street or alley

B. **Production Operations:** The contractor will perform a new trial batch when the plant or plant location is changed. The ODR may suspend production for noncompliance with this Item. The contractor will take corrective action and obtain approval to proceed after any production suspension for noncompliance.

1. **Storage and Heating of Materials:** Do not heat the asphalt binder above the temperatures specified in Item 4.18, "Asphalts, Oils, and Emulsions" or outside the manufacturer's recommended values. On a daily basis, provide the ODR with the records of asphalt binder and hot-mix asphalt discharge temperatures in accordance with Item 4.20, "Equipment for Asphalt Concrete Pavement". Unless otherwise approved, does not store mixture for a period long enough to affect the quality of the mixture.

2. **Mixing and Discharge of Materials:** Notify the ODR of the target discharge temperature and produce the mixture within 25°F of the target. The contractor will monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F. The City will not pay for or allow placement of any mixture produced at more than 350°F. Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant.

3. **Individual Loads of Hot Mix:** The ODR can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, the Contractor may test the rejected load. The ODR will review the test results. If test results are within the operational tolerances shown in Table 8, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load. The contractor will provide a split sample of the material tested to the ODR

C. **Hauling Operations:** Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary to coat truck beds, use a release agent on the approved list maintained by the TxDOT Construction Division.

D. **Placement Operations:** Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly. Place mixture within the compacted lift thickness shown in Table 10, unless otherwise shown on the plans or allowed.

1. **Weather Conditions:** The contractor may place mixture when the air temperature is above 40 degrees and rising and the roadway surface temperature is 60°F or higher unless otherwise approved. If the temperature is 50º and falling, paving operations will cease. Measure the roadway surface temperature with a handheld infrared thermometer. Unless otherwise shown on the plans, place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the ODR, or Engineer.

2. **Tack Coat:** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the ODR. The ODR will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a thin, uniform tack coat to all pavement surfaces, contact surfaces of curbs, structures, and all joints. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. The ODR may use Tex-243-F to verify that the tack

coat has adequate adhesive properties. The ODR may suspend paving operations until there is adequate adhesion.

Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use. If required, verify that emulsified asphalt proposed for use meets the minimum residual asphalt percentage specified in Item 4.18, "Asphalts, Oils, and Emulsions".

The tack coat shall be an asphaltic material such as PG (minimum high temperature grade of PG58) or AC10 in accordance with Item 4.18, "Asphalts, Oils and Emulsions".

3. **Prime Coat:** Prepare the surface by sweeping or other approved methods. When directed, before applying bituminous material, lightly sprinkle the surface with water to control dust and ensure absorption. Use material in accordance with Subsection 4.18, "Asphalts, Oils, and Emulsions."

   Apply bituminous mixture at a rate of 0.20 to 0.40 gals per SY as directed. Apply the mixture when the air temperature is 50°F and rising. Measure the air temperature in the shade away from artificial heat. The ODR will determine when weather conditions are suitable for application. The Engineer will select the application temperature within the limits recommended in Subsection 4.18, "Asphalts, Oils, and Emulsions." Apply material within 15°F of the selected temperature. Distribute the material smoothly and evenly at the rate selected by the ODR.

   Do not permit traffic, hauling, or placement of subsequent courses over freshly constructed prime coats. If the primed surface has accumulated an unsatisfactory amount of dust, the base material shall be either re-primed or a tack coat applied. Approval needs to be given by ODR before mix can be placed. Maintain the primed surface until placement of subsequent courses or acceptance of the work.

E. Lay-Down Operations:

1. **Minimum Mixture Placement Temperatures:** Use Table 9 for suggested minimum mixture placement temperatures.

2. **Windrow Operations:** When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

3. **Placement against Structures:** When placed adjacent to curb and gutter or other structures the surface shall be finished uniformly high so that when completed it will be ¼ inch above the curb and gutter or other concrete structures.

Table 9
Suggested Minimum Mixture Placement Temperature

High-Temperature Binder Grade	Minimum Placement Temperature (Before Entering Paver)
PG 64[1] or lower	260°F
PG 70	270°F
PG 76	280°F
PG 82 or higher	290°F

1. If AC is used, it must meet the requirements of PG 64.

F. **Compaction:** Use air void control unless ordinary compaction control is specified on the plans. The Contractor will set a rolling pattern to reach maximum compaction. Rolling pattern with be determined by qualified personnel for each new paving operation. Avoid displacement of the mixture. If displacement occurs, correct to the satisfaction of the ODR. Ensure pavement is fully compacted before allowing rollers to stand on the pavement. Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture. Unless otherwise directed, operate vibratory rollers in static mode when not compacting, when changing directions, or when the plan depth of the pavement mat is less than 1-1/2 in. Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with the rollers. The ODR may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

1. **Air Void Control:** Compact dense-graded hot-mix asphalt to contain from 5% to 9% in-place air voids. Do not increase the asphalt content of the mixture to reduce pavement air voids. The Contractor will test density and depth a minimum of one test per street or alley. The Contractor will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. The Contractor will average the values obtained for all tests to determine the theoretical maximum specific gravity.

    a) **Rollers:** Furnish the type, size, and number or rollers required for compaction. Use a pneumatic-tire roller to seal the surface, unless otherwise shown on the plans. Use additional rollers as required to remove any roller marks.

    b) **Placement Areas Subject to Removal and Replacement:** If after testing, an area is identified with results of air voids higher than 9% or lower than 5%, the contractor may take additional cores at 50 foot spacing to define the limits of deficiency. If any two consecutive cores show air voids out of the specified range the area between the two cores plus half the distance to the nearest passing core must be removed and replaced. The Contractor will obtain cores in the presence of the ODR.

2. **Ordinary Compaction Control:** Ordinary compaction will be allowed only on maintenance or small utilities projects, unless otherwise specified. The contractor will furnish the type, size, and number or rollers required for compaction, as approved. Furnish at least 1 medium pneumatic-tire roller (minimum 12-ton weight). Use the control strip method given in Tex-207-F, Part IV, to establish rolling patterns that achieve maximum compaction. Follow the selected rolling pattern unless changes that affect compaction occur in the mixture or placement conditions. When such changes occur, establish a new rolling pattern. Compact the pavement to meet the requirements of the plans and specifications.

    When rolling with the 3-wheel, tandem or vibratory rollers, start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides. Proceed toward the center of the pavement, overlapping on successive trips by at least 1 ft., unless otherwise directed. Make alternate trips of the roller slightly different in length. On super elevated curves, begin rolling at the low side and progress toward the high side unless otherwise directed.

G. **Thickness:** Design thickness shall be as shown on the plans. Minimum thickness of hot-mix asphalt is shown in Table 10. The thickness shall not be average thickness.

1. If quality assurance testing show more than ¼" deficiency from the specified minimum thickness prior to being trimmed, the hot-mix surface shall be considered deficient with respect to thickness, and the

deficiency shall be rectified by removal and replacement at the specified thickness at contractor's sole expense.

2. The Contractor may take additional cores at 50 foot spacing to define the limits of deficiency. If any two consecutive cores show deficient thickness the area between the two cores plus half the distance to the nearest passing core must be removed and replaced.

3. No additional compensation will be made to the contractor for thickness of hot-mix surface greater than specified.

4. The Contractor will obtain the cores within 1 working day of the time the placement is completed. Two 6-in.-diameter cores side-by-side from within 1 ft. of the random location provided for the placement test. Mark the cores for identification. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to insure that an adequate bond will be achieved during subsequent placement operations. For Type C, Type D and Type F mixtures, 4-in.-diameter cores are allowed.

Table 10
Required Core Height

Mixture Type	**Minimum Untrimmed Core Height (in.) Eligible for DensityTesting**
A	2.00
B	1.75
C	1.50
D	1.25
F	0.75

H. **Irregularities:** The contractor will immediately take corrective action if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The ODR may suspend production or placement operations until the problem is corrected.

At the expense of the Contractor and to the satisfaction of the ODR, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.

I. **Maintenance Mix:** The vendor, at his expense, will be required to test asphaltic mixture on a monthly basis. The vendor will be required to supply to the City a copy of certified test results. The tests required are asphalt content and gradations shown in Table 5.

V. **RIDE QUALITY:**

A. Type 1 Surface test will be used on residential streets and Type 2 Surface Test will be used on arterial streets. The contractor will perform all testing and supply results to the ODR. Overlays will not be subject to International Roughness Index (IRI) requirements.

1. Type 1 Surface Test will use a 10 foot straight edge to check for irregularities. Use diamond grinding or other methods approved by the ODR to correct surface areas that have more than 1/8 inch variation between 2 contacts on a 10-foot straightedge. For asphalt concrete pavements, fog seal the aggregate exposed from diamond grinding.

2. Type 2 Surface Test will use a high speed or lightweight inertial profiler certified at the Texas Transportation Institute. Provide the ODR with equipment certification documentation. If the IRI is determined to exceed 65 inches per mile corrective action shall be performed by diamond grinding, or other methods approved by the ODR. If the IRI exceeds 95 inches per mile the pavement shall be removed and replaced at the contractor's expense.

VI. **MEASUREMENT:** Hot mix will be measured by the Square Yard, which includes asphalt, aggregate, and additives.

VII. **PAYMENT:** performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Dense-Graded Hot-Mix Asphalt (Method)" of the type, surface aggregate classification, and binder specified. These prices are full compensation for surface preparation, materials including prime coat, tack coat, placement, equipment, labor, tools, testing, and incidentals. Trial batches will not be paid for unless they are incorporated into pavement work approved by the City.